Introduction

The purpose of this brief is to provide a summary of the surface wave modeling results. Only two breakwater modifications will be presented and does not include additional defensive measures that must be incorporated to provide a similar level of protection as the current breakwater configuration. This work is preliminary and may contain errors and omissions. The full coastal engineering analysis will be included in the integrated feasibility report (IFR) to be released at a later time. Only results will be presented and no analysis will be made based on the modeling results in this overview.

Without Project Conditions

Nearshore wave modeling is performed using the spectral wave model, CMS-Wave[1]. For brevity, only the 1 year return period swell events will be shown. Deep water wave conditions are shown in Table 1 with H_s, T_p and D_p defined as the significant wave height, peak period and direction, respectively.

Table 1: Input deep water wave conditions

Wave Condition	**H_s ft.**	**T_p sec**	**D_p °**
1-yr Northwest Swell	12.4	16.0	270.0
1-yr South Swell	5.8	15.0	180.0

Existing conditions (no breakwater modifications) are shown in Figure 1 and Figure 2 for the 1 year return event originating from the northwest and south.

With Breakwater Modification Conditions

Two modifications to the Long Beach Breakwater will be presented; removal of the eastern 1/3 (~4,450 ft.) and two 1000 ft. notches on the western half as shown in Figure 3.

Wave conditions generated from the 1 year return events are shown in Figure 4 – Figure 7 for the two breakwater modifications.

Probability of Occurrence

To determine the probability a wave event may occur, a 3-way joint probability between wave height, period and direction was created. It was found that 526 distinct combinations of these three parameters can define the probability of occurrence. Figure 8 shows the probability, in days per year, that a certain wave condition is exceeded as a result of the without project conditions. Although reported in days/year for ease of communication, this value is actually a probability and events do not need to occur sequentially (i.e. 1 day of exceedance may consist of four separate events that last 6 hours each, 24 events that last for 1 hour, etc.). From the alterations of the Long Beach Breakwater, the probability of exceedance changes as presented in Figure 9 and Figure 10.

[1] U.S. Army Corps of Engineers. 2008. "CMS-Wave: a nearshore spectral wave model for coastal inlets and navigation projects". ERDC/CHL TR-08-13. Coastal Hydraulics Laboratory, Engineering Research and Development Center. Vicksburg, MS

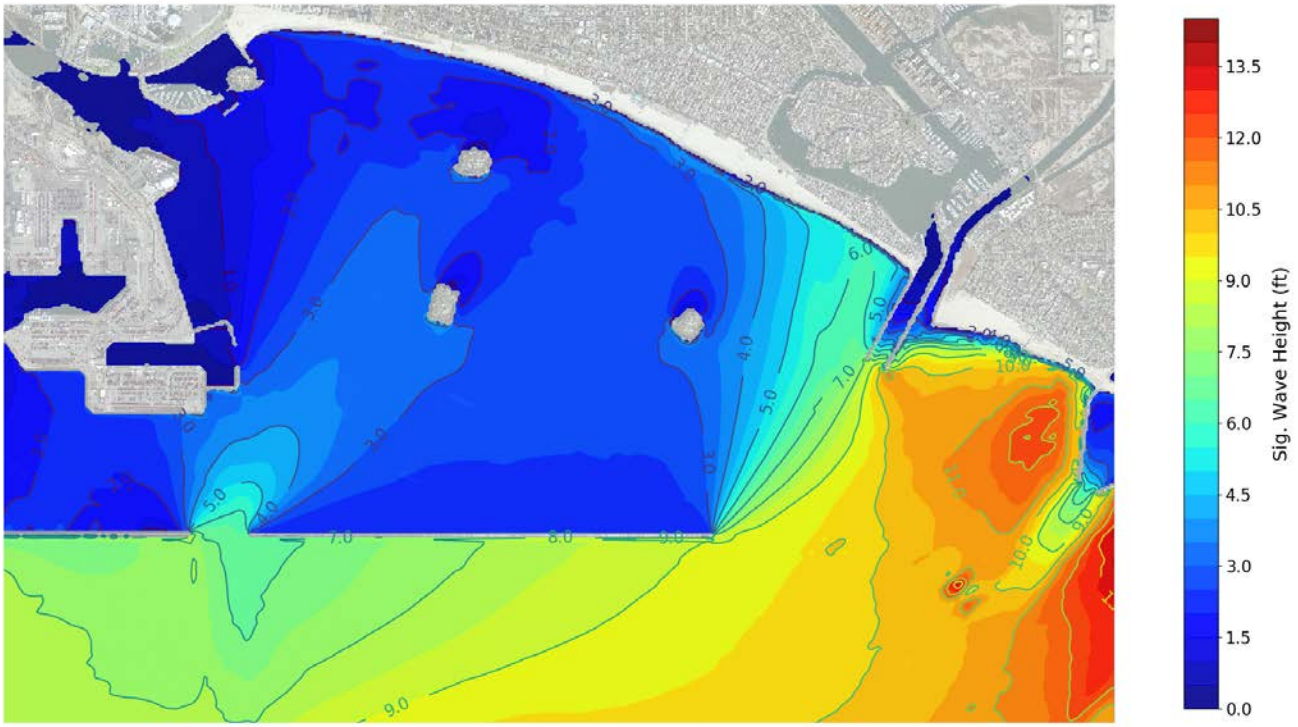

Figure 1: Without project wave conditions for 1-yr return event from the northwest

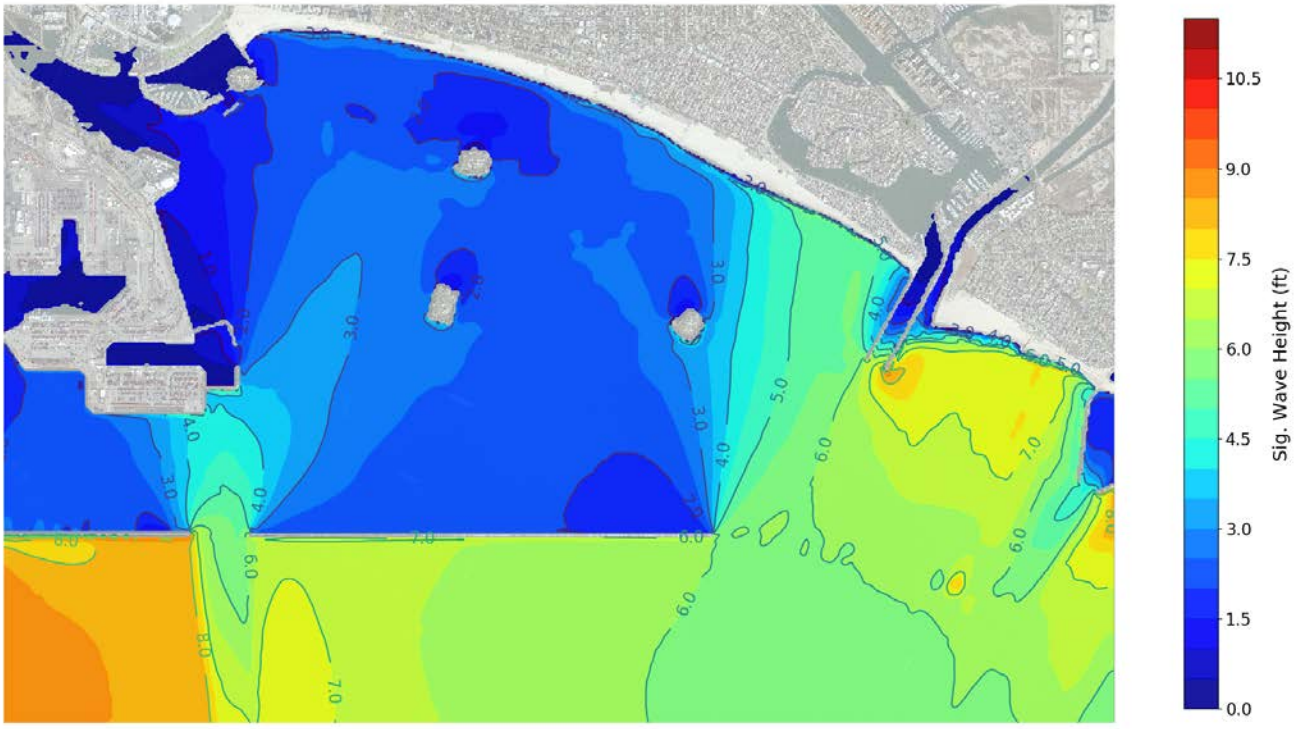

Figure 2: Without project wave conditions for 1-yr return event from the south

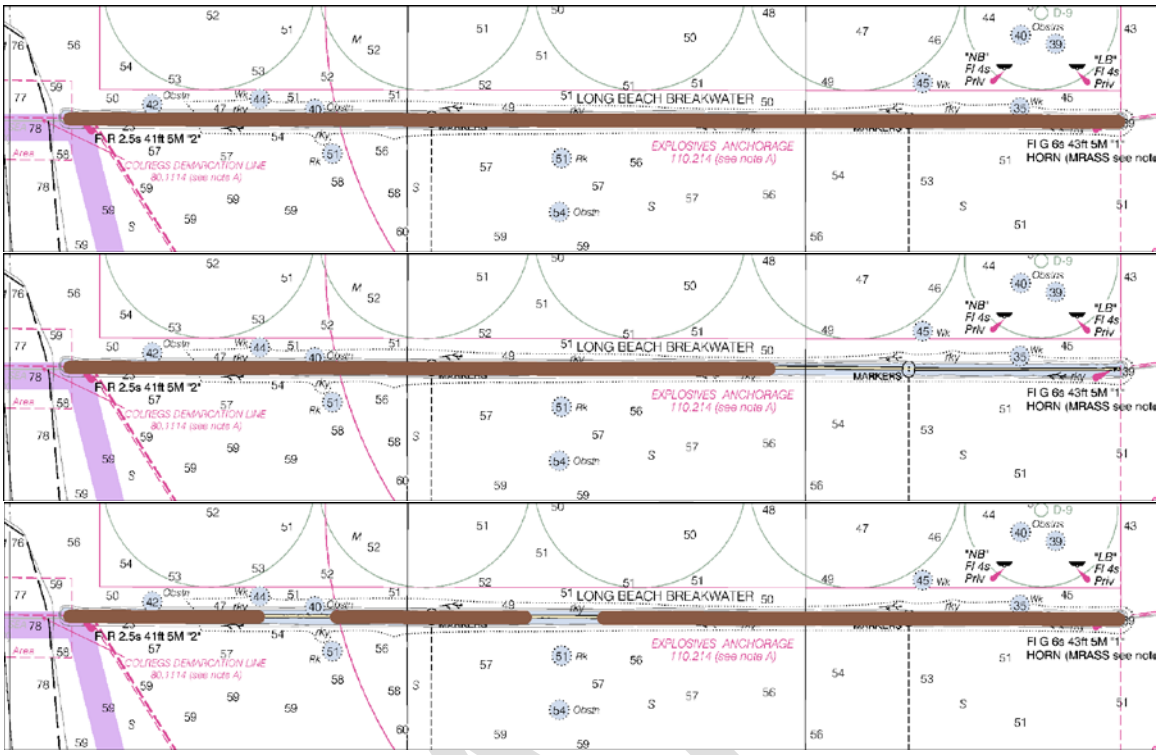

Figure 3: Plan view of existing Long Beach Breakwater (top), removal of the eastern 1/3 (middle) and two 1000 ft. notches on the western half (bottom) overlaid on NOAA Chart 18749

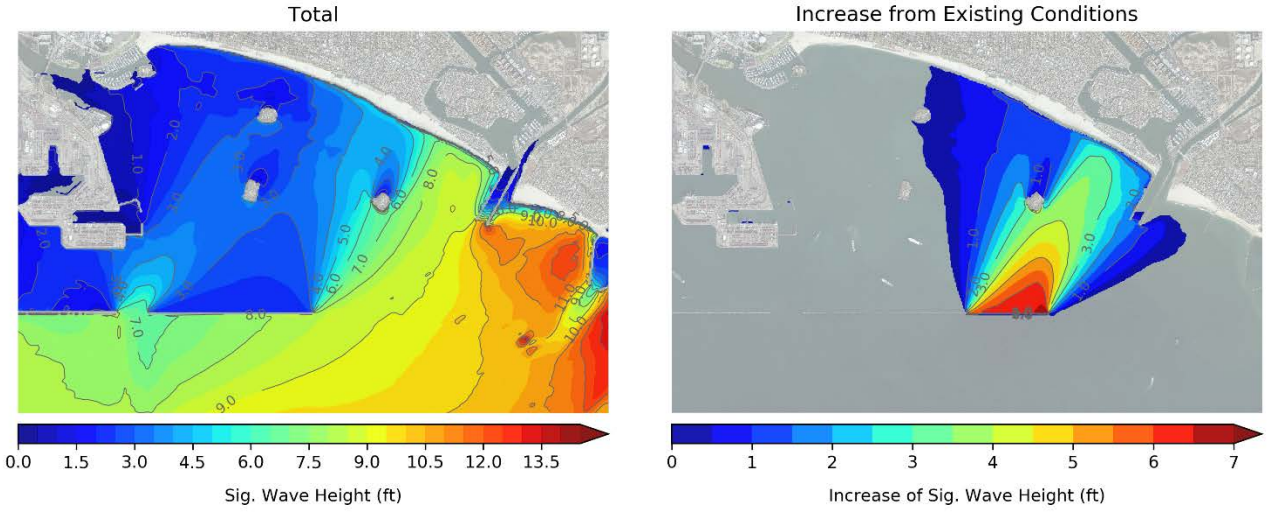

Figure 4: Removal of eastern 1/3 of the Long Beach Breakwater wave conditions for a 1 year return event from the northwest. Complete model output shown on the left and the change from without project conditions shown on the right.

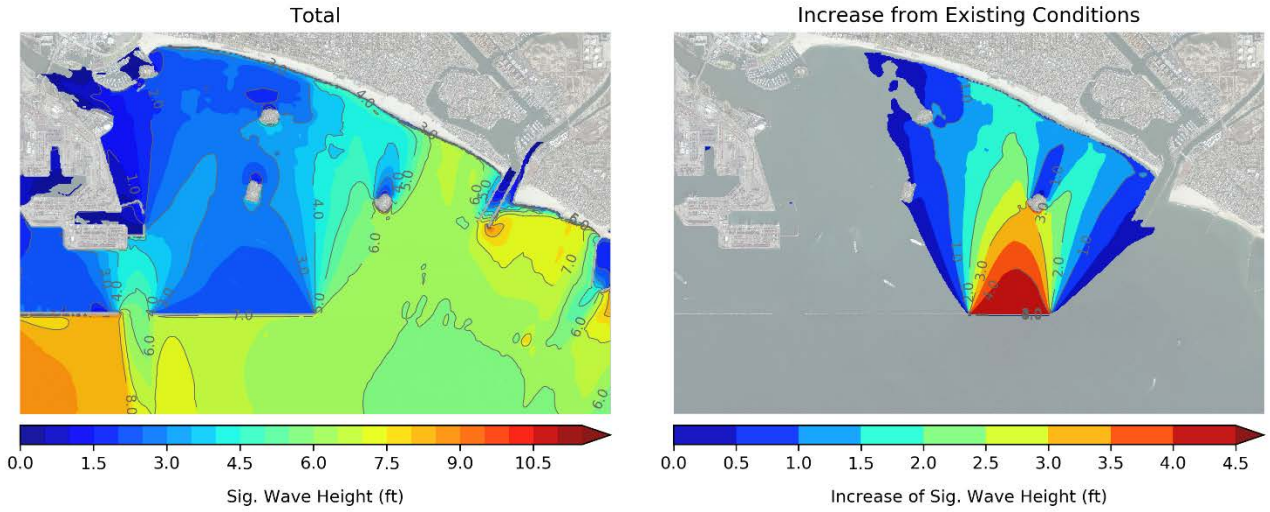

Figure 5: Removal of eastern 1/3 of the Long Beach Breakwater wave conditions for a 1 year return event from the south. Complete model output shown on the left and the change from without project conditions shown on the right.

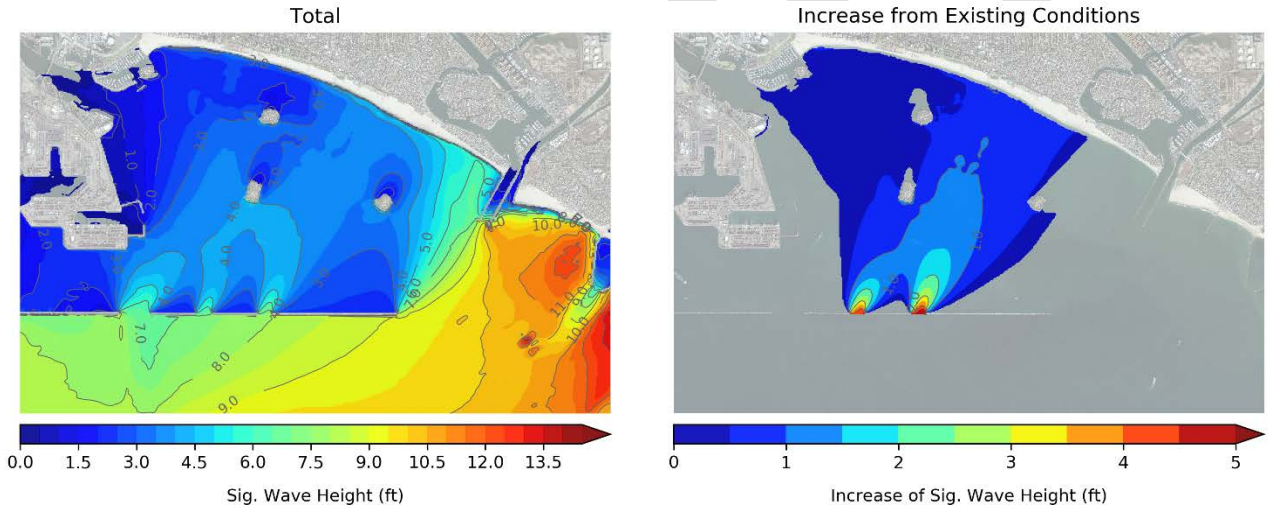

Figure 6: Two 1000 ft. notches in the Long Beach Breakwater wave conditions for a 1 year return event from the northwest. Complete model output shown on the left and the change from without project conditions shown on the right.

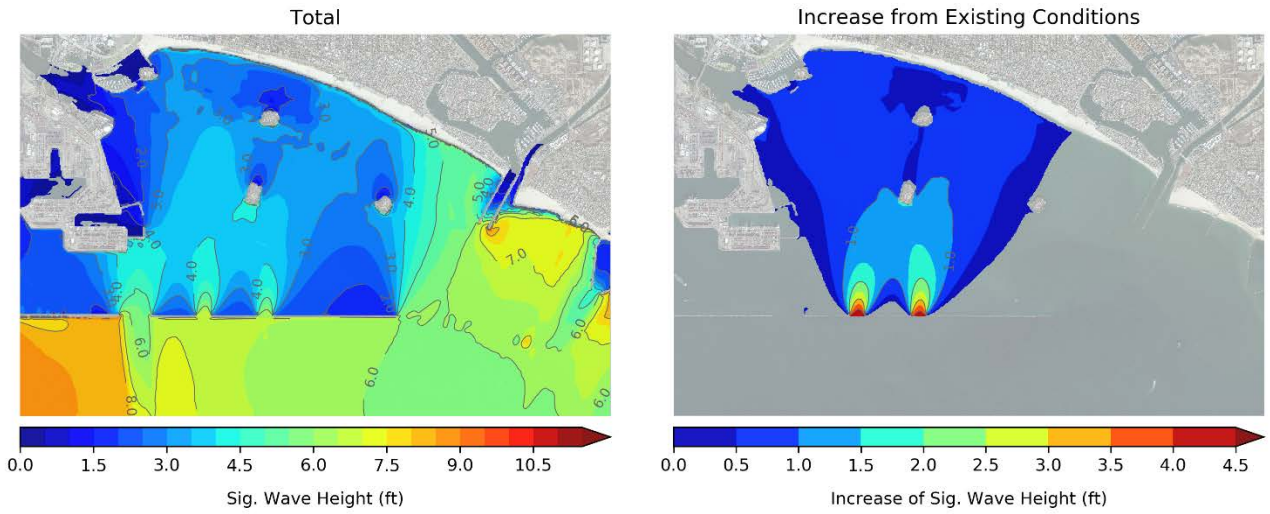

Figure 7: Two 1000 ft. notches in the Long Beach Breakwater wave conditions for a 1 year return event from the south. Complete model output shown on the left and the change from without project conditions shown on the right.

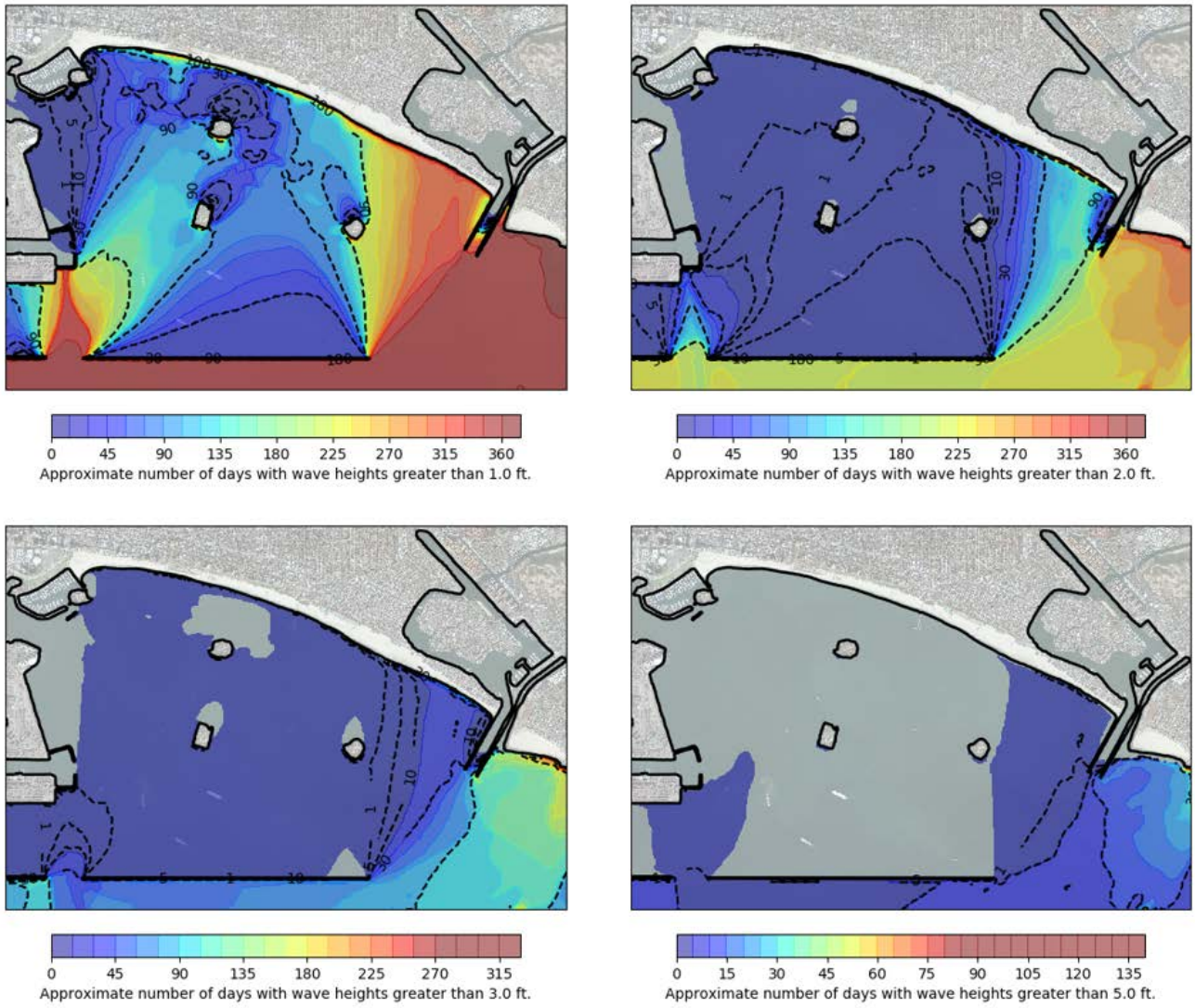

Figure 8: Approximate probability of exceedance for without project conditions

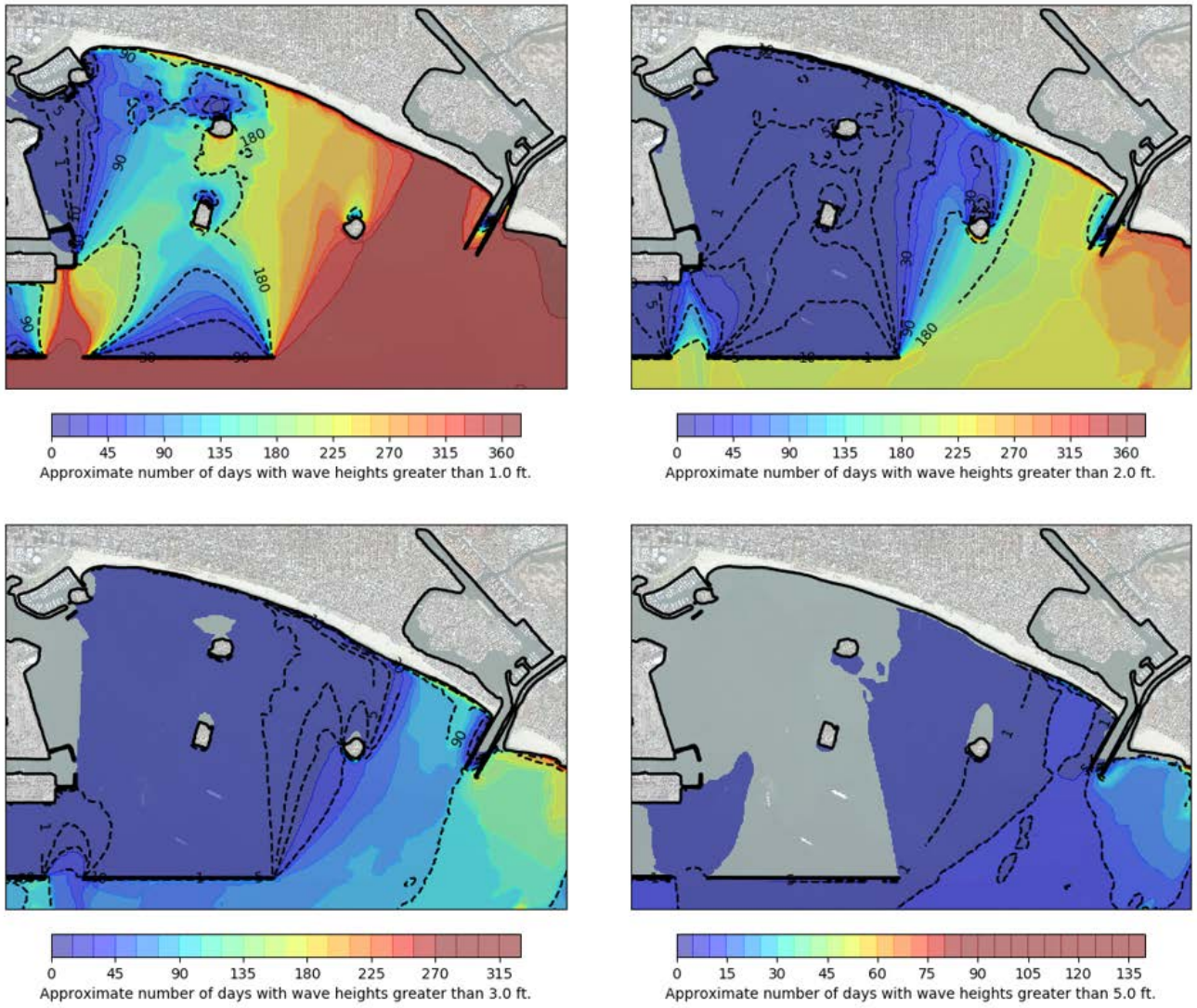

Figure 9: Approximate probability of exceedance for removal of the eastern 1/3 of the Long Beach Breakwater

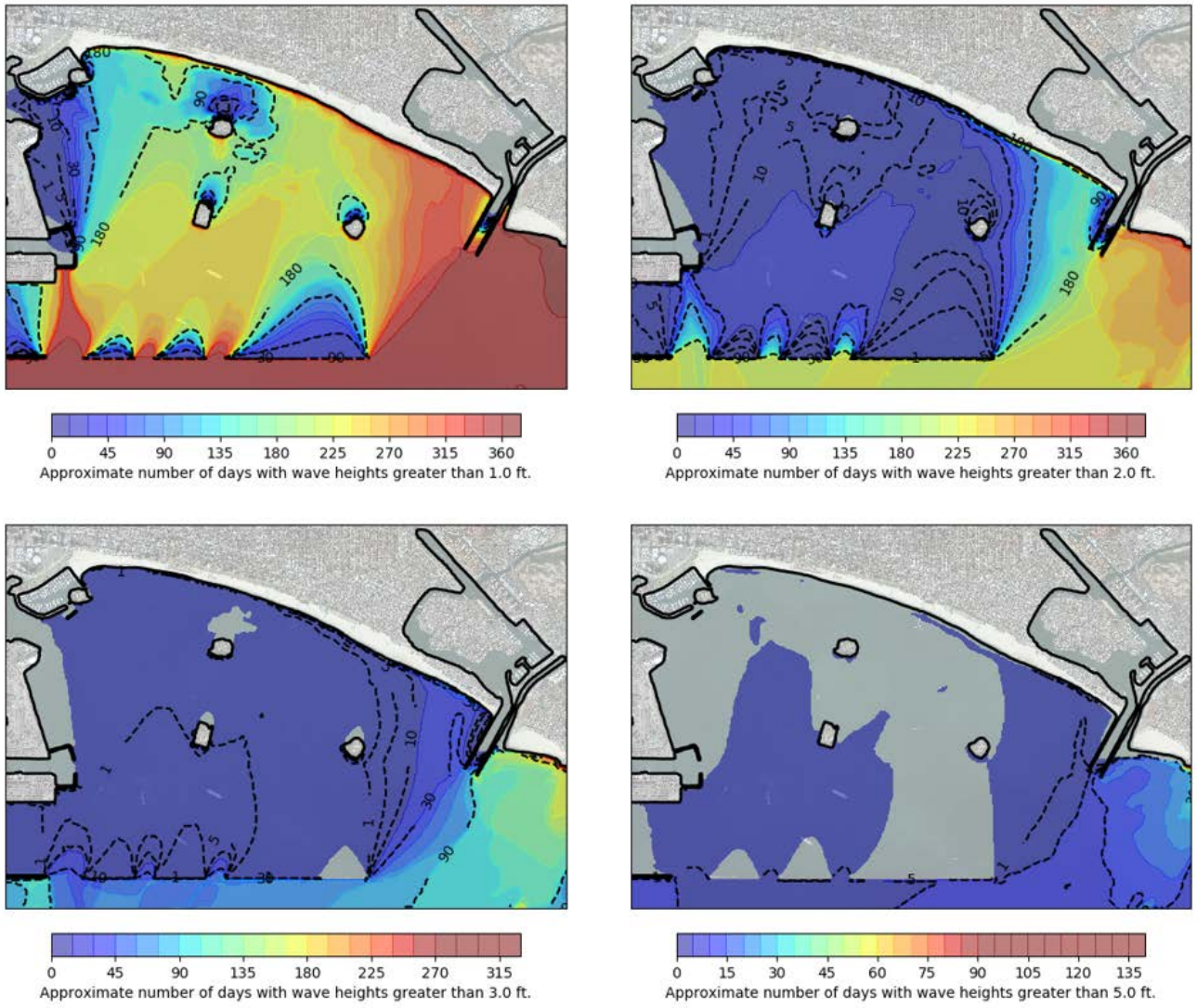

Figure 10: Approximate probability of exceedance for two 1000 ft. notches in the western half of the Long Beach Breakwater